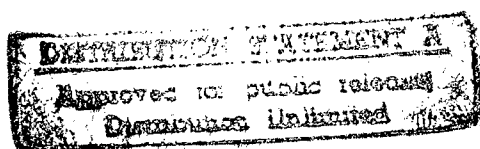


Basewide Energy Systems Plan

19971022 108

Executive Summary

Final Report



Fort Rucker, Alabama

February 1983

Prepared For
MOBILE DISTRICT CORPS OF ENGINEERS
MOBILE, ALABAMA
CONTRACT DACA01-77-C-0094

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Prepared By
BLACK & VEATCH
CONSULTING ENGINEERS
KANSAS CITY, MISSOURI



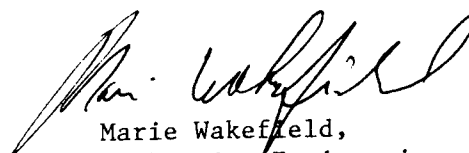
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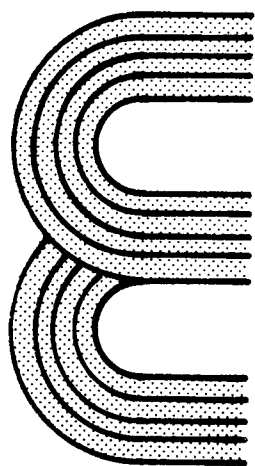
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EXECUTIVE SUMMARY - INCREMENTS A, B, C, D and E

Included in this summary are the results of the first five increments of the Basewide Energy Systems Plan for Fort Rucker, Alabama. This plan includes analyses and recommendations of energy conservation projects for the reduction of the installation's present energy consumption. The savings figures presented in this summary can only be realized after all projects have been implemented. Black & Veatch has developed projects that would meet funding requirements for the energy conservation program. Furthermore, the recommended projects provide partial compliance with the energy conservation requirement for the installation as outlined in the Army Facilities Energy Plan. This summary presents data on the following:

- Existing energy consumption and the basewide energy use model
- Source energy reductions due to energy conservation techniques for buildings and their systems
- Application of solar energy to reduce fossil fuel consumption
- Use of solid waste as an alternate energy source
- Savings utilizing central energy monitoring and control systems (EMCS)

Tables 1 and 2 (all tables are included in Appendix A) present information pertaining to the physical descriptions and energy consumption of 35 typical buildings used to verify historical energy consumption in the development of the basewide energy use model. This model

was then utilized as the foundation for energy conservation project analyses and recommendations. Table 3 summarizes the daily personnel occupancy for each typical building. Tables 1, 2 and 3 also provide information which was used to estimate source energy consumption for similar buildings within the designated groupings.

The foundation for the basewide energy model was the estimated average annual source energy consumed by each of the significant building groups, as indicated in Table 4, totalling 1,822,240 mega-Btu per year. The model was within 2 percent of the FY 75 historical source energy consumption shown below.

FY 75 Source Energy
Consumption in Btu x 10⁶

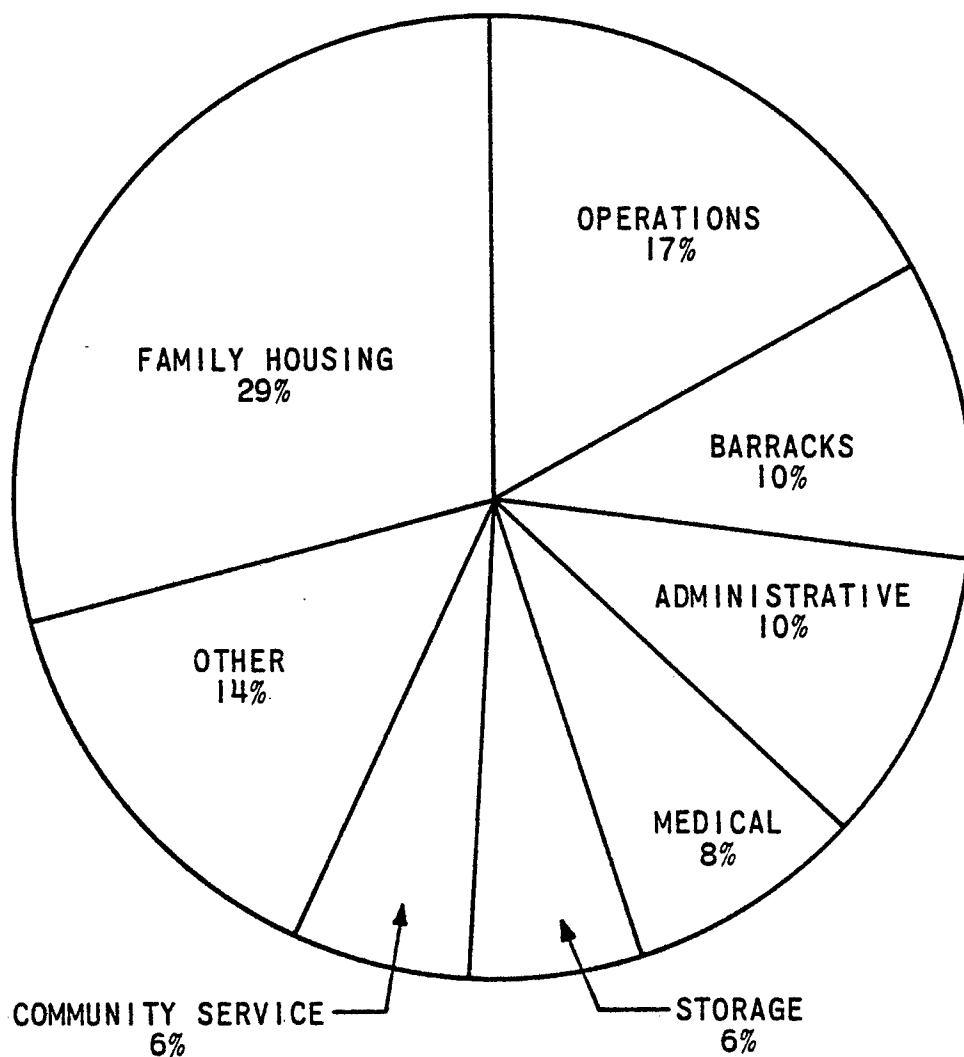
| | |
|----------------|---------------|
| Electricity | 918,279 |
| Natural Gas | 759,502 |
| Propane Gas | 6,947 |
| Fuel Oil No. 2 | 90,484 |
| Fuel Oil No. 5 | <u>22,982</u> |

TOTAL 1,798,194

The estimated annual percentage of source energy consumption for all building types contributing to the historical basewide annual total consumed during base year 1975, is shown on Figure 1.

Further explanation of the historical energy consumption and development of the basewide energy model can be found in the Energy Use Survey.

The total estimated source energy savings due to implementation of all feasible energy conservation projects developed within Increments A, B, C, D, and E of this study is 630,344 mega-Btu per year. These



FY'75 CONSUMPTION
(1,798,194 x 10⁶ BTU'S)

FIGURE 1

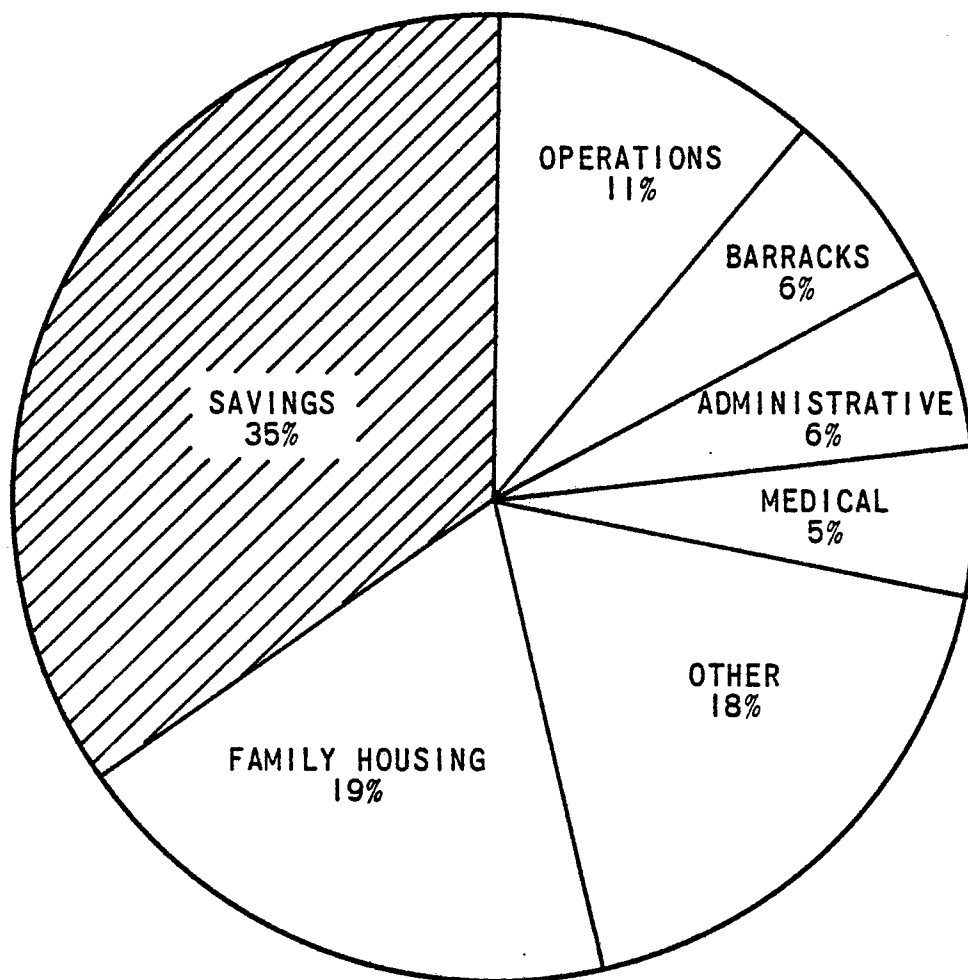
projects consisted of various architectural improvements, and mechanical and electrical system modifications, and are summarized in Tables 5 and 6.

Table 5 presents, by building type, the source energy savings and the percent basewide reduction to be realized by implementation of each of the projects. Figure 2 illustrates the combined effect of the recommended energy saving improvements, as compared to the FY 1975 source energy expenditure. Our calculations indicate a savings of 630,344 mega-Btu per year, approximately 35 percent, over the base year (1975). Figure 3 illustrates the allocation of the energy conservation projects savings for significant building groups.

Table 6 was developed to give a prioritized schedule, in order of fiscal year, for implementing the recommended energy conservation projects. A detailed analysis of the projects listed in Tables 5 and 6, and further explanation of the energy conservation analysis can be found in the Energy Use Survey.

Nine concepts for the reduction of Fort Rucker's dependence on nonrenewable energy sources by utilizing solar energy, a renewable energy source, were evaluated. This evaluation resulted in the recommendation of Project No. 43500 which indicated a total savings of 2,040 mega-Btu per year. The nine concepts and analyses are presented in the Solar Energy Applications and Evaluation.

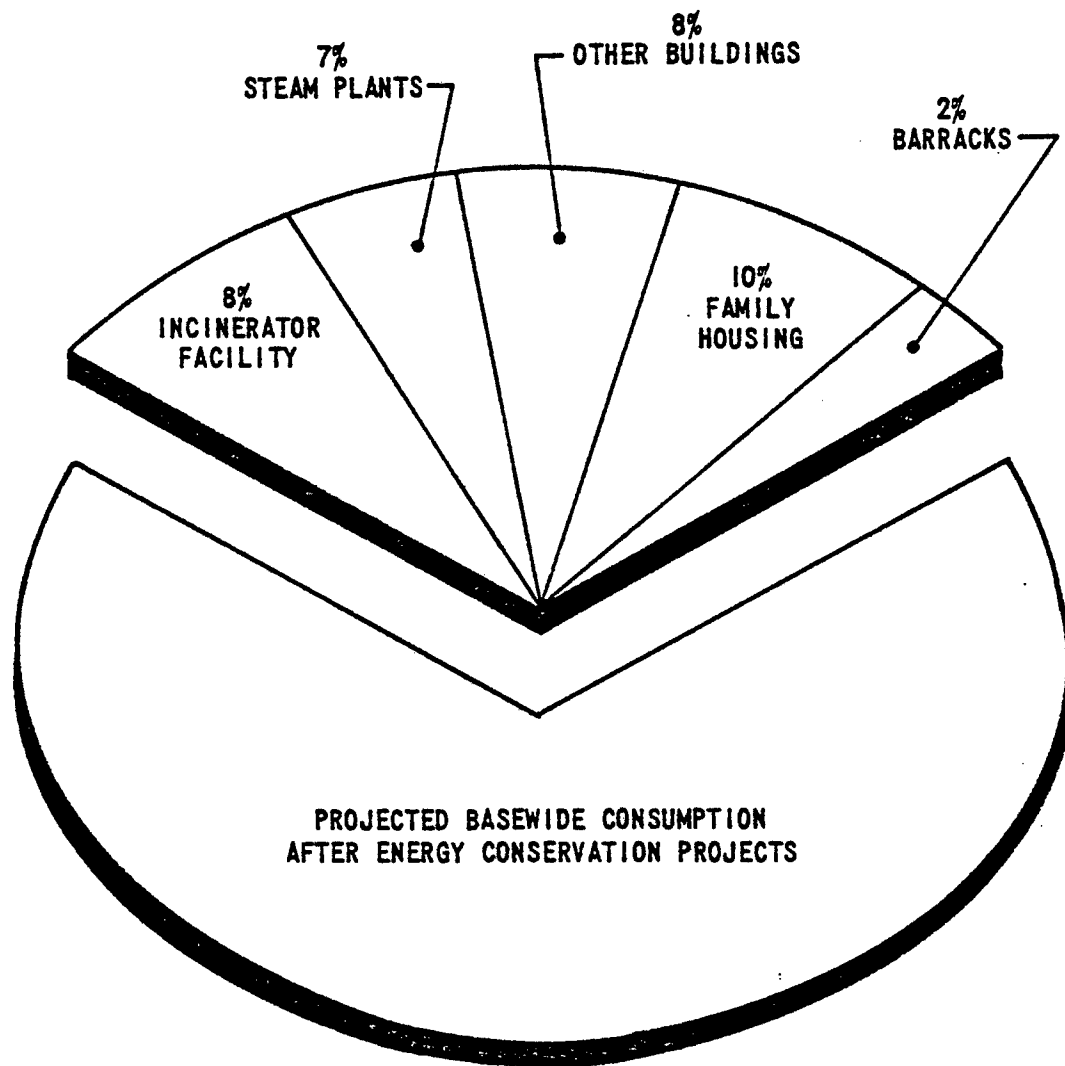
The report on Energy Monitoring and Control Systems (EMCS) includes recommendations for an extension of the existing system (design completed by Newcomb and Boyd, Consulting Engineers) and the utilization of an FM



BASEWIDE CONSUMPTION AFTER ENERGY
CONSERVATION PROJECTS

(1,169,489 x 10⁶ BTU'S)

FIGURE 2



ALLOCATION OF ENERGY
CONSERVATION PROJECTS SAVINGS
FOR SIGNIFICANT BUILDING GROUPS

FIGURE 3

control system. An extension of the existing system (EMCS Phase III) would result in a savings of 28,744 mega-Btu per year, while the FM control system would save 75,308 mega-Btu per year.

The investigation of solid waste for reducing source energy consumption at Fort Rucker resulted in the development of Project No. 224. This project recommends the installation of a solid waste burning incinerator facility to provide steam to the existing steam distribution system. The proposed plant would enable the installation to retire one of the two existing heating plants (Nos. 6021 or 4701), thereby reducing fuel oil and electric consumption totalling 142,535 mega-Btu per year. The details and descriptions of the systems analyzed can be found in the report, Total Energy, Selective Energy, and Central Boiler Plants.

The incorporation of a total energy or selective energy (TE/SE) system at this installation is not recommended. The application of TE/SE systems was rejected due to the relative low steam demand and the high cost of expanding the existing steam distribution system.

EXECUTIVE SUMMARY-INCREMENTS F AND G

Increment F - Facilities Engineer Conservation Measures.

Increment G - Maintenance, Repair, and Minor Construction Projects.

This is a summary of the two phases of work that were started after the completion of Increments A, B, C, D, and E in May of 1980. Increments F and G were completed in December, 1982.

The purpose of Increment F of the Basewide Energy Systems Plan is to identify and develop recommendations that can be used by Fort Rucker in preparing its energy management plan. Included are a number of comparatively low cost projects, recommendations for training, and prioritized lists of possible energy conservation measures. Increment G identified maintenance, repair, and minor construction projects for the purpose of conserving energy. These are energy conservation projects that did not meet ECIP criteria or did not fit the ECIP program at the time that the remainder of the study was completed.

The average costs of energy for FY 1981 are given in Table 7. These costs have been used as the basis for determining the dollar savings due to energy conservation.

Projects developed within the scope of Increments F and G of the study are summarized in Tables 8 and 9 respectively, and are prioritized by their E/C ratio. The E/C ratio is defined as the ratio of yearly energy savings in million Btu to the cost estimate in thousands of dollars. Any project showing a payback of 15 years or less is recommended. Material and labor cost estimates are representative of April, 1981 prices.

Five 1391's were prepared which combined twelve of the projects developed under Increments F and G. The ECIP documentation for these projects appears in Appendix B of Volume V.

The first project, Ceiling Fans and Destratifiers, involves installation of ceiling fans in 26 high ceiling buildings and portable de-stratifying fans in aircraft maintenance hangars.

The Window Treatment project is a combination of three projects: window insulation for 76 buildings where 100 percent visibility is not needed and diffuse sunlight is beneficial, application of solar film to nine administrative type buildings, and installation of insulated panels over unnecessary windows in ten buildings.

The Automatic Chiller Condenser Tube Cleaning project involves installation of a free-floating brush in all chiller tubes and one four-way flow reversing valve in each chiller in ten buildings.

Weatherization is a combination of four projects: weatherstripping exterior doors in 175 buildings, application of blown-on insulation on the walls and/or ceilings of 47 buildings, installation of aluminum storm windows on 155 buildings, and addition of insulation to the underside of the floor in 24 buildings.

The fifth project involves expansion of the EMCS and FM Control Systems.

The total estimated source energy savings due to implementation of all the recommended projects in Increment F is 294,543 mega-Btu per year. The total estimated savings due to implementation of all recommended projects in Increment G is 144,205 mega-Btu per year.

CONCLUSION

The projected future energy savings at Fort Rucker due to implementation of the scheduled ECIP projects developed under Increments A, B, C, D and E, construction of the Solid Waste Incinerator Facility, and implementation of the recommended projects from Increments F and G, is shown in Figure 4. The following projects comprise the "Scheduled ECIP's" section of Figure 4:

| | |
|---------|---|
| T-41100 | Insulated Panels, Storm Windows, and Weatherstrip Doors in Permanent Buildings. |
| T-41200 | Insulation, Weatherstripping, and Storm Windows in Temporary Buildings. |
| T-41300 | Storm Windows, Weatherstrip Doors and Kitchen Lighting Fixture in Family Housing. |
| T-41500 | FM Radio Control System. |
| T-42200 | Family Housing Equipment Modifications. |
| T-42400 | Steam Plant Modifications. |
| T-44500 | EMCS Phase III. |

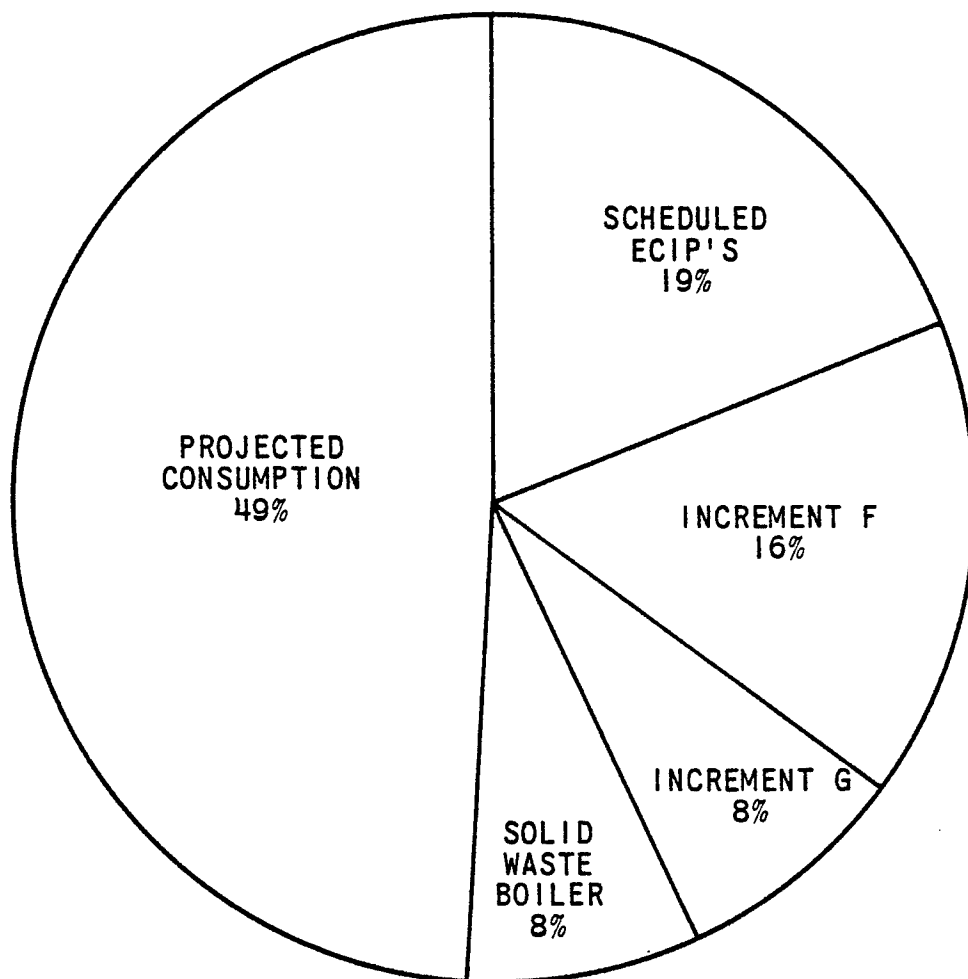
Figure 5 is a forecast of future energy costs at Fort Rucker. The graph compares how costs could escalate if no energy conservation projects were implemented versus energy costs if all cost effective projects are implemented. The energy conservation projects are assumed to be implemented in the following three phases:

Phase I - Scheduled ECIP projects

Phase II - Solid Waste Incinerator Facility

Phase III - Increments F and G projects

Figure 5 does not account for new building construction.



FORT RUCKER
BASEWIDE CONSUMPTION FY'81

FIGURE 4

EFFECT OF ESCALATION AND ENERGY CONSERVATION ON FUEL COST

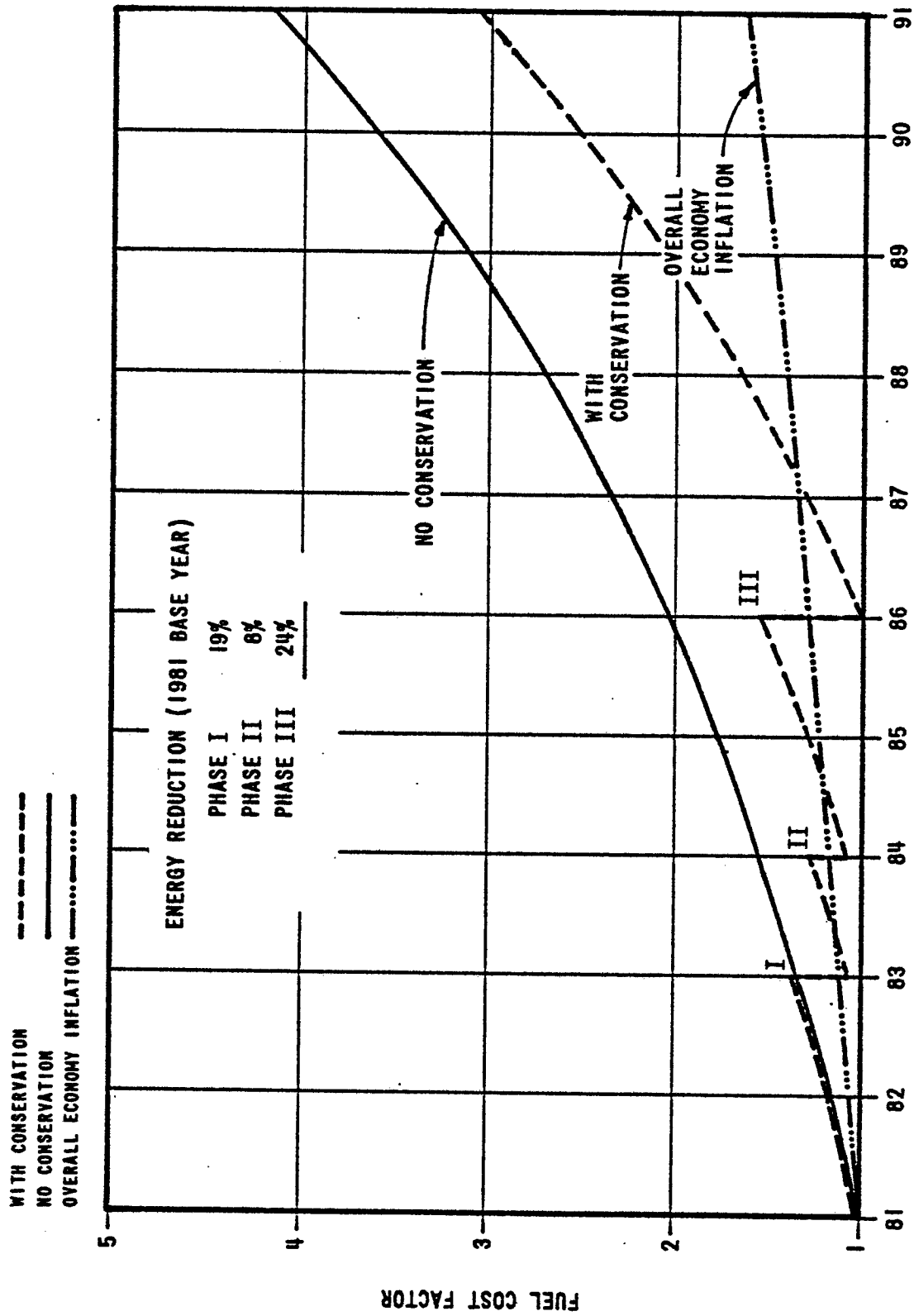


FIGURE 5

APPENDIX

TABLES

TABLE I
TYPICAL BUILDING CONSTRUCTION DATA
FORT RUCKER

| GROUP NO. | BLDG. NO. | BUILDING DESCRIPTION | NO. FLS. | CONSTRUCTION | | | | | | | | U" VALUES | | | | | | | | WINDOM SQ. FT. | AREA (FT. 2) | COOLING | | HEATING | | PEAK TRNS LOAD THRU | DOMESTIC HOT WATER CAP. (G) | | | | | |
|-----------|-----------|--------------------------|----------|--------------------|---------------------------|---------------------------|--------------------|-------------------|------|------|-------|-----------|------|--------|-------------|--------|------|------|------|----------------|--------------|---------|--|---------|------|---------------------|-----------------------------|-------|-------|-------|-------------|-----|
| | | | | ROOF | WALL | FLOOR | WINDOM | DOOR | ROOF | WALL | FLOOR | WINDOM | DOOR | SYSTEM | CAP. (TONS) | SYSTEM | FUEL | GAIN | LOSS | | | | | | | | | | | | | |
| A-1 | 8700 | USARV HOUSING | 1 | COMPOSITE SHINGLES | T & G ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .26 | .23 | .53 | 1.13 | .49 | 234 | | | | | | | | | | | | 9 | B.P. 8795 STEAM | 48.5 | 109.5 | 90 | STEAM ELEC. | |
| A-2 | 812 | AIRCRAFT MAINT. OFFICE | 2 | BUILT-UP SHINGLES | BRICK ON CONC. FRAME | SLAB ON GRADE | SINGLE CLEAR GLASS | STEEL HOLLOW CORE | .10 | .25 | — | 1.13 | .55 | 1088 | | | | | | | | | | | | 42 | B.P. 1102 STEAM | 78.6 | 202.6 | 90 | GAS | |
| A-3 | 704 | VEHICLE MAINT. OFFICE | 1 | COMPOSITE SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .05 | .26 | .84 | 1.13 | .49 | 189 | | | | | | | | | | | | 2 | CENTRAL UNIT | GAS | 9.9 | 41.2 | 40 | GAS |
| B-1 | 8509 | BARRACKS | 3 | BUILT-UP SHINGLES | BRICK ON CONC. FRAME | TILE, VENTED CRANK SPACE | SINGLE CLEAR GLASS | STEEL HOLLOW CORE | .04 | .29 | .82 | 1.13 | .49 | 9043 | | | | | | | | | | | | 87 | B.P. 8701 STEAM | 229.0 | 644.0 | 200 | STEAM | |
| B-2 | 313 | BOQ | 2 | BUILT-UP SHINGLES | BRICK ON CONC. FRAME | SLAB ON GRADE | SINGLE CLEAR GLASS | STEEL HOLLOW CORE | .16 | .29 | — | 1.13 | .55 | 1836 | | | | | | | | | | | | 40 | B.P. 311 STEAM | 107.0 | 250.5 | 150 | STEAM | |
| B-3 | 8749 | BARRACKS | 1 | COMPOSITE SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .06 | .23 | .48 | 1.13 | .49 | 384 | | | | | | | | | | | | — | B.P. 8795 STEAM | — | 140.5 | 78 | GAS | |
| B-4 | 129 | BOQ | 2 | COMPOSITE SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .05 | .26 | .84 | 1.13 | .49 | 744 | | | | | | | | | | | | 15 | BOILER | GAS | 90.1 | 173.1 | 150 | GAS |
| B-5 | 6904 | BARRACKS | 2 | COMPOSITE SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .05 | .26 | .84 | 1.13 | .49 | 744 | | | | | | | | | | | | — | BOILER | GIL | — | 173.1 | 100 | GAS |
| C-1 | 3712 | SUNDAY SCHOOL CLASSROOMS | 2 | COMPOSITE SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .26 | .26 | .84 | 1.13 | .49 | 436 | | | | | | | | | | | 1 | BOILER | GIL | 8.16 | 172.2 | 15 | OIL | |
| C-2 | 3710 | STORAGE A | 1 | COMPOSITE SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .05 | .26 | .84 | 1.13 | .49 | 270 | | | | | | | | | | | — | — | FURNACE UNIT NTRS. | GAS | — | 90.1 | — | — |
| C-3 | 8740 | MEDICAL SUPPLY | 1 | COMPOSITE SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .26 | .23 | .53 | 1.13 | .49 | 288 | | | | | | | | | | | 16 | B.P. 8795 STEAM | 90.0 | 181.1 | 150 | STEAM | | |
| C-4 | 207 | YOUTH CLUB | 2 | ASPHALT SHINGLES | WOOD SIDING ON WOOD FRAME | LINOLEUM OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .27 | .32 | .81 | 1.13 | .49 | 1568 | | | | | | | | | | | 56 | BOILER | GAS | 159.4 | 389.0 | 90 | GAS (R117) | |
| E-1 | 4508 | MESS HALL | 1 | BUILT-UP SHINGLES | BRICK ON CONC. FRAME | TILE, CLOSED CRANK SPACE | SINGLE CLEAR GLASS | METAL HOLLOW CORE | .33 | .32 | .24 | 1.13 | .55 | 1537 | | | | | | | | | | | 40 | B.P. 8701 STEAM | 41.9 | 212.0 | 200 | STEAM | | |
| F-1 | 2517 | SINGLE FAMILY HOUSING | 1 | ASPHALT SHINGLES | BRICK ON WOOD FRAME | SLAB ON GRADE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .07 | .26 | — | 1.13 | .49 | 285 | | | | | | | | | | | 8 | FURNACE | GAS | 14.1 | 41.1 | 30 | GAS | |
| F-2 | 2240 | DOXLEY HOUSING | 1 | ASPHALT SHINGLES | WOOD SIDING ON BRICK | SLAB ON GRADE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .11 | .16 | — | 1.13 | .49 | 485 | | | | | | | | | | | 3 | FURNACE | GAS | 28.0 | 61.1 | 90 | GAS | |
| H-1 | 301 | HOSPITAL | 2 | BUILT-UP SHINGLES | BRICK ON CONC. BLOCK | TILE, VENTED CRANK SPACE | SINGLE CLEAR GLASS | METAL HOLLOW CORE | .10 | .37 | .61 | 1.13 | .55 | 850 | | | | | | | | | | | 392 | B.P. 311 STEAM | 10.1 | — | — | — | — | |
| H-2 | 8733 | VISION RESEARCH | 1 | COMPOSITE SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .26 | .26 | .54 | 1.13 | .49 | 144 | | | | | | | | | | | 13 | B.P. 8795 STEAM | 10.1 | — | — | — | — | |
| L-1 | 1012 | LAUNDRY | 1 | METAL | CLAPBOARD ON WOOD FRAME | SLAB ON GRADE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .24 | .21 | — | 1.13 | .49 | 918 | | | | | | | | | | | 1.25 | WINDOM UNIT | — | 10.1 | — | — | — | — |
| M-1 | 4004 | TRUCK MAINTENANCE | 1 | COMPOSITE SHINGLES | ASBESTOS ON WOOD FRAME | SLAB ON GRADE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .44 | .27 | — | 1.13 | .49 | 231 | | | | | | | | | | | — | BOILER | OIL | — | 78.8 | 42 | ELEC. | |
| M-2 | 8712 | VEHICLE MAINTENANCE | 1 | BUILT-UP SHINGLES | CONCRETE & CHU | SLAB ON GRADE | SINGLE CLEAR GLASS | STEEL HOLLOW CORE | .11 | .31 | — | 1.13 | .55 | 947 | | | | | | | | | | | — | B.P. 8701 STEAM | — | 151.7 | — | — | — | |
| M-3 | 1413 | WORK SHOP | 1 | COMPOSITE SHINGLES | CLAPBOARD ON WOOD FRAME | SLAB ON GRADE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .44 | .26 | — | 1.13 | .49 | 504 | | | | | | | | | | | 2 | BOILER | GAS | 7.5 | 135.0 | 90 | GAS | |
| O-1 | 6410 | GRAB FLIGHT, SUPPLY | 1 | ASPHALT SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .26 | .20 | .84 | 1.13 | .49 | 535 | | | | | | | | | | | — | FURNACE | GAS | — | 119.4 | 40 | ELEC. | |
| O-2 | 4511 | BATTALION HEADQUARTERS | 1 | BUILT-UP SHINGLES | BRICK ON CONC. FRAME | SLAB ON GRADE | SINGLE CLEAR GLASS | STEEL HOLLOW CORE | .06 | .30 | — | 1.13 | .55 | 1036 | | | | | | | | | | | 40 | B.P. 8701 STEAM | 50.1 | 137.5 | 42 | ELEC. | | |
| O-3 | 801 | OFFICE & STORAGE | 2 | COMPOSITE SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .26 | .26 | .47 | 1.13 | .49 | 446 | | | | | | | | | | | 6 | BOILER | GAS | 51.4 | 181.9 | 40 | GAS | |
| O-4 | 5205 | CLASSROOM & AUDITORIUM | 1 | BUILT-UP SHINGLES | BRICK & CONC. FRAME | TILE, BASEMENT | WINDOM | STEEL HOLLOW CORE | .16 | .27 | .84 | — | .55 | 0 | | | | | | | | | | | 101 | B.P. 4021 STEAM | 73.5 | 202.4 | 90 | GAS | | |
| S-1 | 3208 | STORAGE | 2 | COMPOSITE SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .26 | .26 | .54 | 1.13 | .49 | 908 | | | | | | | | | | | — | BOILER | DIL | — | 54.2 | 50 | OIL (R117) | |
| S-2 | 8009 | WAREHOUSE | 1 | ASPHALT SHINGLES | ASBESTOS ON WOOD FRAME | SLAB ON GRADE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .26 | .27 | — | 1.13 | .49 | 280 | | | | | | | | | | | — | SPACE NTR. | ELEC. | — | 7.05 | — | — | |
| S-3 | 1309 | WAREHOUSE | 1 | ASPHALT SHINGLES | METAL ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .45 | .40 | .54 | 1.13 | .49 | 209 | | | | | | | | | | | — | UNIT NTRS. | GAS | — | 318.6 | 40 | GAS | |
| S-4 | 105 | BOOKSTORE/STORAGE | 1 | ASPHALT SHINGLES | CLAPBOARD ON WOOD FRAME | TILE, OPEN CRANK SPACE | SINGLE CLEAR GLASS | WOOD SOLID CORE | .26 | .20 | .84 | 1.13 | .49 | 336 | | | | | | | | | | | 10 | BOILER | GAS | 98.1 | 106.3 | — | — | |

*1010

TABLE 1 (CONT'D)

[illegible]

TABLE 2
TYPICAL BUILDING ENERGY CONSUMPTION DATA
FORT RUCKER

| GROUP NO. | BLDG. | BUILDING DESCRIPTION | ANNUAL ENER. SOURCE CONSUMPTION BTU x 10 ⁶ | | | ELEC'L ENER. CONSUMPTION | | BTU x 10 ³ FT ² |
|-----------|-------|----------------------------|---|-------|-------|--------------------------|---------|--|
| | | | FUEL | ELEC. | TOTAL | KW PEAK | KWH/YR | |
| A-1 | 8708 | USAARL HDQTRS. | 384 | 398 | 782 | 23 | 34270 | 347.6 |
| A-2 | 412 | AIRCRAFT MAINT. OFFICE | 1382 | 4152 | 5534 | 129 | 357910 | 379.0 |
| A-3 | 704 | VEHICLE MAINT. OFFICE | 141 | 94 | 237 | 6 | 8290 | 329.2 |
| B-1 | 4509 | BARRACKS | 2670 | 3711 | 6381 | 126 | 319910 | 126.0 |
| B-2 | 313 | BOQ | 3228 | 935 | 4163 | 13 | 80570 | 229.6 |
| B-3 | 8749 | BARRACKS | 756 | 134 | 892 | 3 | 11700 | 205.1 |
| B-4 | 129 | BOQ | 847 | 771 | 1618 | 38 | 66430 | 201.1 |
| B-5 | 6904 | BARRACKS | 1091 | 330 | 1421 | 7 | 28440 | 176.7 |
| C-1 | 3712 | SUNDAY SCHOOL CLASSROOMS | 727 | 85 | 812 | 7 | 7340 | 152.9 |
| C-2 | 3710 | STORAGE & DRIVERS TRAINING | 307 | 97 | 404 | 3 | 8350 | 134.7 |
| C-3 | 8740 | MEDICAL SUPPLY | 731 | 459 | 1190 | 28 | 39550 | 291.5 |
| C-4 | 207 | YOUTH CLUB | 1731 | 1093 | 2824 | 62 | 94190 | 132.6 |
| E-1 | 4508 | MESS HALL | 2415 | 3982 | 6397 | 108 | 343300 | 564.4 |
| F-1 | 21517 | SINGLE FAMILY HOUSING | 171 | 257 | 428 | 9 | 22140 | 272.6 |
| F-2 | 22460 | DUPLEX FAMILY HOUSING | 276 | 478 | 754 | 16 | 41210 | 274.0 |
| H-1 | 301 | HOSPITAL | 53499 | 25577 | 79076 | 411 | 2377370 | 841.8 |
| H-2 | 8733 | VISION RESEARCH | 810 | 1243 | 2053 | 55 | 107160 | 459.3 |
| L-1 | 1012 | LAUNDRY | 23946 | 1379 | 25325 | 82 | 118890 | 481.9 |
| M-1 | 4004 | TRUCK MAINTENANCE | 180 | 143 | 323 | 10 | 12290 | 103.9 |
| M-2 | 4712 | VEHICLE MAINTENANCE | 234 | 68 | 302 | 2 | 5820 | 62.7 |
| M-3 | 1413 | WORK SHOP | 276 | 72 | 348 | 5 | 6220 | 64.7 |
| O-1 | 6410 | GRAD FLIGHT, SUPPLY | 505 | 70 | 575 | 2 | 6034 | 230.0 |
| O-2 | 4511 | BATTALION HEADQUARTERS | 531 | 2325 | 2856 | 76 | 200520 | 445.1 |
| O-3 | 801 | OFFICE & STORAGE | 940 | 321 | 1261 | 15 | 27640 | 237.5 |
| O-4 | 5205 | CLASSROOM & AUDITORIUM | 8191 | 1516 | 9707 | 32 | 130700 | 487.0 |
| S-1 | 3208 | STORAGE | 574 | 39 | 613 | 1 | 3320 | 115.4 |
| S-2 | 8009 | WAREHOUSE | 0 | 58 | 58 | 3 | 5000 | 18.7 |
| S-3 | 1309 | WAREHOUSE | 711 | 779 | 1490 | 17 | 67160 | 165.6 |
| S-4 | 105 | BOOKSTORE/STORAGE | 493 | 285 | 718 | 15 | 24400 | 305.5 |

TABLE 2 (CONT'D)
TYPICAL BUILDING ENERGY CONSUMPTION DATA
FORT RUCKER

[illegible]

TABLE 3
BUILDING OCCUPANCY
FORT RUCKER

| GROUP NO. | BLDG. | BUILDING DESCRIPTION | NORMAL PEAK POPULATION | OCCUPANCY |
|-----------|-------|----------------------------|------------------------|--|
| A-1 | 8708 | USAARL HQQTRS. | 16 | WEEKDAYS - 8:00 A.M. TO 5:00 P.M. |
| A-2 | 412 | AIRCRAFT MAINT. OFFICE | 52 | WEEKDAYS - 7:30 A.M. TO 5:30 P.M. |
| A-3 | 704 | VEN. MAINT. SHOP | 5 | WEEKDAYS - 7:30 A.M. TO 4:15 P.M. |
| B-1 | 4509 | BARRACKS | 184 | OPEN 24 HOURS |
| B-2 | 313 | B.O.Q. | 40 | OPEN 24 HOURS |
| B-3 | 8749 | BARRACKS | 23 | OPEN 24 HOURS |
| B-4 | 129 | B.O.Q. | 16 | OPEN 24 HOURS |
| B-5 | 6904 | BARRACKS | 43 | OPEN 24 HOURS |
| C-1 | 3712 | SUNDAY SCHOOL CLASSROOMS | 40 | WEEKDAYS - 7:30 A.M. TO 3:30 P.M. SUNDAY - 8:15 A.M. TO 11:00 A.M. & 3:30 P.M. TO 6:00 P.M. |
| C-2 | 3710 | STORAGE & DRIVERS TRAINING | 11 | WEEKDAYS - 7:00 A.M. TO 3:00 P.M. |
| C-3 | 8740 | MEDICAL SUPPLY | 9 | WEEKDAYS - 7:30 A.M. TO 4:15 P.M. |
| C-4 | 207 | YOUTH CLUB | 30 | WEEKDAYS - 7:30 A.M. TO 8:00 P.M. SATURDAY - 1:00 P.M. TO 10:00 P.M. |
| E-1 | 4508 | MESS HALL | 300 | 7 DAYS A WEEK - 3:30 A.M. TO 6:30 P.M. |
| F-1 | 21517 | SINGLE FAMILY HOUSING | 4 | OPEN 24 HOURS |
| F-2 | 22460 | DUPLEX FAMILY HOUSING | 8 | OPEN 24 HOURS |
| H-1 | 301 | HOSPITAL | 529 | OPEN 24 HOURS |
| H-2 | 8733 | VISION RESEARCH | 12 | WEEKDAYS - 7:00 A.M. TO 5:00 P.M. |
| L-1 | 1012 | LAUNDRY | 22 | WEEKDAYS - 7:30 A.M. TO 4:00 P.M. |
| M-1 | 4004 | TRUCK MAINTENANCE | 20 | WEEKDAYS - 6:30 A.M. TO 3:30 P.M. |
| M-2 | 4712 | VEHICLE MAINTENANCE | 28 | WEEKDAYS 8:00 A.M. TO 4:00 P.M. |
| M-3 | 1413 | WORK SHOP | 16 | WEEKDAYS - 7:30 A.M. TO 4:15 P.M. |
| O-1 | 6410 | GRAD FLIGHT SUPPLY | 2 | WEEKDAYS - 7:30 A.M. TO 4:15 P.M. |
| O-2 | 4511 | BATTALION HEADQUARTERS | 35 | OPEN 24 HOURS |
| O-3 | 801 | OFFICE & STORAGE | 40 | WEEKDAYS - 7:30 A.M. TO 4:15 P.M. |
| O-4 | 5205 | CLASSROOM & AUDITORIUM | 223 | WEEKDAYS ; 7:30 A.M. TO 4:15 P.M. & 5:00 P.M. TO 9:00 P.M. |
| S-1 | 3206 | STORAGE | N/A | ONLY WHEN SOMETHING IS BEING STORED OR REMOVED |
| S-2 | 8009 | WAREHOUSE | 2 | WEEKDAYS - 7:00 A.M. TO 5:00 P.M. |
| S-3 | 1309 | WAREHOUSE | 8 | WEEKDAYS - 7:30 A.M. TO 4:30 P.M. |
| S-4 | 105 | BOOKSTORE/STORAGE | 21 | WEEKDAYS - 10:00 A.M. TO 6:00 P.M. |
| U-1 | 9806 | SEWAGE TREATMENT | 2 | OPEN 24 HOURS - 7 DAYS A WEEK |
| U-2 | 9804 | PUMPING STATION | — | — |
| U-4 | 311 | STEAM PLANT | 1 | OPEN 24 HOURS - 7 DAYS A WEEK |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

TABLE 4

Building Group Source Energy Consumption

| <u>Group</u> | <u>Description</u> | <u>Group Sq. Ft.</u> | <u>Total Source Consumption⁶ Btu's x 10⁶</u> |
|--------------|--|--------------------------|--|
| A | Administrative | 492,387 | 171,349 |
| B | Barracks | 1,091,182 | 202,585 |
| C | Community Service | 667,169 | 101,318 |
| E | Dining | 55,888 | 31,537 |
| F | Family Housing | 2,122,560 | 581,455 |
| H | Hospital | 235,584 | 148,883 |
| L | Laundry | 52,551 | 25,325 |
| M | Maintenance | 447,738 | 30,248 |
| O | Operations | 823,068 | 310,094 |
| S | Supply and Storage, Warehouse | 725,538 | 113,166 |
| U-1 | Sewage Treatment | 3,987 | 8,078 |
| U-3 | Pump Houses | 12,958 | 11,149 |
| U-4 | Boiler Plants | 23,887 | 2,101 |
| Z | Electric Only (includes outdoor lights) | 83,040 | <u>84,952</u> |
| Total | | | 1,822,240 |

ENERGY CONSERVATION PROJECTS
SOURCE ENERGY SAVINGS - FORT RUCKER, ALABAMA

| BUILDING TYPE | ENERGY SAVINGS BTUx1,000,000 | % BASEWIDE REDUCTION FY'75 | PROJECT NUMBER |
|---------------------------------------|---------------------------------|-------------------------------|-------------------|
| FAMILY HOUSING | 84,974 | 4.73 | T-41300 |
| | 46,026 | 2.56 | T-41500 |
| | 45,746 | 2.54 | T-42200 |
| | <u>176,746</u> | <u>9.83</u> | |
| BARRACKS | 14,384 | 0.80 | T-42300 |
| | 14,279 | 0.79 | T-41100 |
| | 6,312 | 0.35 | T-41200 |
| | 1,652 | 0.09 | T-41400 |
| | 6,192 | 0.34 | T-44500 |
| | <u>42,819</u> | <u>2.37</u> | |
| INCINERATOR FACILITY | 142,535 | 7.93 | 224 |
| STEAM PLANTS | 20,734 | 1.15 | T-42400 |
| | 98,183* | 5.46 | T-42500 |
| | <u>118,917</u> | <u>6.61</u> | |
| OTHER BUILDINGS AFFECTED BY ECIP'S | 29,282 | 1.63 | T-41500 |
| | 62,293 | 3.46 | T-41200 |
| | 21,578 | 1.20 | T-41400 |
| | 3,694 | 0.21 | T-42100 |
| | 2,040 | 0.11 | T-43500 |
| | 6,628 | 0.37 | T-42300 |
| | 1,260 | 0.07 | T-41100 |
| | 22,552 | 1.25 | T-44500 |
| | <u>149,327</u> | <u>8.30</u> | |
| | | | |
| TOTAL | 630,344 | 35.05 | |

*ENERGY SAVINGS WOULD BE $90,314 \times 10^6$ BTU'S IF BLDG. NO. 4701 IS RETIRED DUE TO INSTALLATION OF INCINERATOR FACILITY.

TABLE 5

ENERGY CONSERVATION PROJECTS DEVELOPED SCHEDULE - FORT RUCKER, ALABAMA

| PROJECT TITLE | PROJECT NUMBER | RECOMMENDED FISCAL YEAR | COST \$ x 1000 | E/C RATIO | ENERGY SAVINGS BTUx1,000,000 | YEARS PAYBACK | B/C RATIO |
|---|----------------|-------------------------|----------------|-----------|------------------------------|---------------|-----------|
| STORM WINDOWS, WEATHERSTRIP DOORS AND KITCHEN LIGHTING FIXTURE IN FAMILY HOUSING. | T-41300 | 1980 | 2,073 | 43.18 | 84,974 | 6.22 | 2.82 |
| FM RADIO CONTROL SYSTEM | T-41500 | 1980 | 592 | 127.2 | 75,308 | 2.02 | 5.7 |
| INSULATION, WEATHERSTRIPPING, AND STORM WINDOWS IN TEMPORARY BUILDINGS. | T-41200 | 1980 | 1,348 | 50.88 | 68,605 | 4.51 | 1.89 |
| RELAMPING FLUORESCENT FIXTURES | T-41400 | 1980 | 289 | 80.45 | 23,230 | 1.7 | 4.70 |
| TOTAL | | | 4,302 | | 252,117 | | |
| SOLID WASTE BURNING INCINERATOR FACILITY | 224 | 1981 | 4,079 | 34.9 | 142,535 | 8.36 | 2.75 |
| FAMILY HOUSING EQUIPMENT MODIFICATIONS | T-42200 | 1981 | 1,443 | 33.4 | 45,746 | 10.02 | 1.79 |
| ADJUST FRESH AIR QUANTITIES | T-42300 | 1981 | 30 | 696.0 | 21,012 | .41 | 43.68 |
| STEAM PLANT MODIFICATIONS | T-42400 | 1981 | 354 | 58.6 | 20,734 | 3.97 | 4.99 |
| INSULATE PANELS, STORM WINDOWS, AND WEATHER-STRIP DOORS IN PERMANENT BUILDINGS. | T-41100 | 1981 | 471 | 33.0 | 15,539 | 5.11 | 3.6 |
| CEILING FANS IN AIRCRAFT HANGARS AND MAINTENANCE FACILITIES | T-42100 | 1981 | 60 | 61.75 | 3,694 | 3.81 | 5.02 |
| SOLAR HEATING OF FIELDHOUSE SWIMMING POOL AND SHOWER WATER | T-43500 | 1981 | 112 | 18.3 | 2,040 | 10.7 | 1.77 |
| TOTAL | | | 6,549 | | 251,300 | | |
| UPGRADE COOLING SYSTEMS | T-42500 | 1982 | 1,085 | 90.5 | 98,183 | 4.57 | 4.23 |
| EMCS PHASE III | T-44500 | 1982 | 621 | 46.27 | 28,744 | 6.36 | 1.95 |
| TOTAL | | | 1,399 | | 126,927 | | |

TABLE 6

TABLE 7

FY81 Average
Energy Costs

| | |
|------------------------------|--------------|
| Electricity | |
| Demand | \$5.59/kW |
| kWh (without demand) | \$0.0198/kWh |
| kWh (including demand) | \$0.0370/kWh |
| Natural Gas | |
| Commodity (including demand) | \$3.33/mcf |
| Propane | |
| Commodity | \$0.5540/gal |
| Fuel Oil | |
| No. 2 | \$1.22/gal |
| No. 5 | \$0.87/gal |

TABLE 8
Summary of Increment F Projects

| Project | Location(s) | Energy Savings/Year kWh/yr | Dollar Savings/Year | Payback Years | E/C | B/C | Contract Cost | Reference | | Pages Narr. Calcs. |
|---|---------------------|----------------------------|---------------------|---------------|-------|-----|---------------|-----------|-----------------|--------------------|
| | | | | | | | | Material | Manhours | |
| Reduction of Domestic Water Temperature in Barracks | 10 Buildings | 875 | \$ 4,104 | .05 | 4,550 | 641 | \$ 192 | - | Laborer 10 | 34 A17 |
| Reduction of Ventilation Air Quantities | 25 Buildings | 38,090 | 243,854 | .06 | 2,727 | 424 | 13,970 | \$6,704 | A/C Mech. 228 | 27 A13 |
| Cycle Pool Pumps | 4 Buildings | 1,334 | 5,629 | .09 | 2,531 | 142 | 527 | 395 | Electrician 6.5 | 33 A16 |
| Filter Maintenance | Postwide | 23,223 | 87,837 | .10 | 2,285 | 206 | 10,164 | 2,338 | Laborer 425 | 31 A15 |
| Swimming Pool Cover | 4,605 | 1,948 | 8,722 | .20 | 1,104 | 153 | 1,765 | - | - | 12 A3 |
| Receptacle Insulation | Family Housing | 16,784 | 74,653 | .32 | 696 | 80 | 24,115 | 4,005 | Laborer 1,040 | 22 A9 |
| Turn Off Hot Water | 21 Buildings | 1,013 | 4,749 | .32 | 671 | 95 | 1,510 | - | Plumber 42 | 19 A7 |
| Insulate Water Heaters | 120 Gal. - Nat. Gas | 11 | 52 | .43 | 494 | 70 | 22.40 | 13 | Laborer .5 | 37 A19 |
| Insulate Water Heaters | 80 Gal. - Nat. Gas | 8.6 | 40 | .48 | 440 | 62 | 19.57 | 10 | Laborer .5 | 37 A19 |
| × Bulb - Type Thermostats | Postwide | 88,580 | 490,246 | .47 | 383 | 60 | 231,441 | 194,800 | A/C Mech. 1,148 | 41 A22 |
| Insulate Water Heaters | 40 Gal. - Nat. Gas | 6.2 | 29 | .58 | 367 | 502 | 16.75 | 7 | Laborer .5 | 37 A19 |
| Insulate Water Heaters | 120 Gal. - Electric | 6.2 | 26 | .92 | 258 | 24 | 23.82 | 14 | Laborer .5 | 37 A19 |

TABLE 8 (Cont'd)
Summary of Increment F Projects

| Project | Location(s) | Energy Savings/Year MBtu | Dollar Savings/Year | Payback Years | E/C | B/C | Contract Cost | Reference | | Pages Narr. Calcs. |
|---|-----------------|-----------------------------|---------------------|---------------|-----|-----|---------------|---------------|-------------|--------------------|
| | | | | | | | | In-House Cost | Manhours | |
| | | | | | | | | Material | | |
| ✓ Thermostatic Steam Valves | 8301 | 448 | \$ 2,101 | .92 | 233 | 33 | \$ 1,924 | \$ 917 | Plumber | 28 39 A20 |
| ✓ Insulate Water Heaters | 80 Gal. - Elec. | 4.7 | 20 | 1.04 | 229 | 21 | 20.43 | 11 | Laborer | .5 37 A19 |
| ✓ Weatherstrip Doors | 175 Buildings | 56,463 | 31,540 | .92 | 194 | 28 | 29,111 | 7,860 | Laborer | 1,099 10 A2 |
| ✓ Insulate Water Heaters | 40 Gal. Elec. | 3.3 | 14 | 1.24 | 192 | 17 | 17.31 | 8 | Laborer | .5 37 A19 |
| ✓ Duct Insulation in Unconditioned Spaces | 4 Buildings | 305 | 1,491 | 1.27 | 160 | 22 | 1,900 | 811 | Laborer | 56 16 A5 |
| ✗ Reduce Infiltration in Family Housing | Family Housing | 26,804 | 116,444 | 1.81 | 127 | 13 | 210,528 | 72,858 | Laborer | 7,120 23 A10 |
| ✓ Variable Air Volume | 4905 | 2,666 | 11,251 | 5.6 | 42 | 4 | 63,327 | 53,231 | Electrician | 500 29 A14 |
| ✓ Replace Incandescent Lights | 63 Buildings | 13,884 | 82,742 | 4.9 | 35 | 4 | 402,588 | 239,314 | Electrician | 4,558 35 A18 |
| ✓ Solar Film | 9 Buildings | 963 | 4,215 | 7.6 | 30 | 3 | 31,961 | - | - | 20 A8 |
| ✓ Window Insulation | 5 Buildings | 149 | 878 | 7.0 | 24 | 4 | 6,148 | 2,729 | Laborer | 177 14 A4 |
| ✓ Install Dropped Ceiling and Insulate Floor | 8301 | 162 | 760 | 12.1 | 18 | 3 | 9,175 | 6,778 | Laborer | 124 40 A21 |
| ✓ Window Insulation | 71 Buildings | 2,814 | 21,687 | 7.4 | 18 | 3 | 160,587 | 71,267 | Laborer | 4,620 14 A4 |
| ✓ Roof Spray Cooling | 5205 | 118 | 556 | 12.6 | 17 | 3 | 6,985 | - | - | - 42 A23 |
| ✓ Replace Incandescent Light Fixtures in Family Housing | Family Housing | 4,757 | 23,811 | 30.7 | 7 | 6 | 731,237 | 463,525 | Electrician | 7,367 9 A1 |

TABLE 8 (Cont'd)
Summary of Increment F Projects

| Project | Location(s) | Energy Savings/Year MMBtu | Dollar Savings/Year | Payback Years | E/C | B/C | Contract Cost | Reference | | Pages Narr. Calcs. |
|-------------------------|-------------------------------------|---------------------------------|------------------------|------------------|-----|-----|------------------|---------------------------|-------------|-----------------------|
| | | | | | | | | In-House Cost Material | Manhours | |
| Flush Valve Restrictors | 52 Buildings | 0 | \$ 4,944 | 2.55 | 0 | 4 | \$12,539 | \$ 7,776 | Laborer 246 | 17 A6 |
| Toilet Tank Dams | Family Housing and 149 Buildings | 0 | 11,564 | 2.60 | 0 | 4 | 29,705 | 17,793 | Laborer 616 | 25 A11 |
| | | | | | | | | 5,118 | Laborer 177 | 25 A11 |

TABLE 9

Summary of Increment G Projects

| Project | Location (s) | Energy Savings/Year MMBtu | Dollar Savings/Year | Payback Years | E/C | B/C | Contract Cost | In-house Cost | | Reference Pages Narr. Calcs. |
|--|--------------|------------------------------|---------------------|---------------|-----|-----|---------------|---------------|-----------------------------------|---------------------------------|
| | | | | | | | | Material | Manhours | |
| Barracks HVAC Modifications | 6 Buildings | 6,525 | \$41,019 | .63 | 253 | 37 | \$25,812 | 10,771 | A/C Mechanic 162 Electrician 8 | 31 B13 |
| FH Control System Expansion | 38 Buildings | 5,220 | 29,002 | 1.11 | 162 | 14 | 37,233 | 24,367 | Electrician 388 | 20 B7 |
| Automatic Chiller-Condenser Tube Cleaning | 301 | 6,885 | 52,877 | .94 | 139 | 25 | 49,692 | ----- | ----- | 13 B4 |
| Swimming Pool Heater | 4605 | 1,228 | 5,759 | 1.78 | 120 | 17 | 10,260 | 9,685 | Plumber 16 | 8 B1 |
| Automatic Chiller-Condenser Tube Cleaning | 4901 | 3,306 | 13,951 | 2.49 | 95 | 9 | 34,777 | ----- | ----- | 13 B4 |
| Automatic Chiller-Condenser Tube Cleaning | 5102 | 3,306 | 13,951 | 2.49 | 95 | 9 | 34,777 | ----- | ----- | 13 B4 |
| De-stratifiers | 5 Buildings | 1,829 | 22,347 | .91 | 90 | 26 | 20,283 | 16,922 | Electrician 151 | 28 B12 |
| Automatic Chiller-Condenser Tube Cleaning | 4701 | 1,552 | 6,549 | 3.08 | 77 | 7 | 20,198 | ----- | ----- | 13 B1 |
| Automatic Chiller-Condenser Tube Cleaning | 4502 | 1,980 | 15,206 | 1.72 | 76 | 14 | 26,089 | ----- | ----- | 13 B1 |
| Ceiling Fans | 26 Buildings | 7,152 | 41,649 | 2.40 | 73 | 12 | 98,051 | 42,204 | Electrician 1,684 | 17 B6 |
| PHES-Extension | 5 Buildings | 13,787 | 59,598 | 3.38 | 68 | 4 | 201,454 | ----- | ----- | 22 B8 |
| Automatic Chiller-Condenser Tube Cleaning | 4905 | 1,584 | 12,165 | 2.03 | 64 | 12 | 24,644 | ----- | ----- | 13 B1 |

TABLE 9 (Cont'd)

Summary of Increment G Projects

| Project | Location (s) | Energy Savings/Year MMBtu | Dollar Savings/Year | Payback Years | E/C | B/C | Contract Cost | In-House Cost | | Reference Pages | |
|--|---------------|------------------------------|---------------------|---------------|-----|-----|---------------|---------------|----------------------------|-----------------|--------|
| | | | | | | | | Material | Manhours | Narr. | Calcs. |
| Automatic Chiller Condenser Tube Cleaning | 6005 | 1,584 | 12,165 | 2.03 | 64 | 12 | 24,644 | ----- | ----- | 13 | B1 |
| Fluorescent Lighting Load Reduction | Postwide | 15,072 | 92,394 | 2.90 | 56 | 7 | 268,596 | 195,235 | Electrician 2,210 | 24 | B9 |
| Automatic Chiller Condenser Tube Cleaning | 113 | 1,218 | 14,178 | 1.63 | 53 | 15 | 23,106 | ----- | ----- | 13 | B1 |
| Automatic Chiller Condenser Tube Cleaning | 308 | 921 | 7,073 | 3.06 | 43 | 8 | 21,642 | ----- | ----- | 13 | B1 |
| Automatic Chiller Condenser Tube Cleaning | 2908 | 891 | 4,179 | 5.15 | 41 | 6 | 21,536 | ----- | ----- | 13 | B1 |
| Floor Insulation | 24 Buildings | 21,200 | 99,428 | 6.33 | 34 | 5 | 629,827 | 395,891 | Carpenter 8,182 | 37 | B16 |
| Boiler Upgrade | 50 Buildings | 13,140 | 79,132 | 5.50 | 30 | 5 | 434,690 | 295,074 | Plumber 3,888 | 11 | B3 |
| Insulated Panels | 10 Buildings | 858 | 4,914 | 6.40 | 27 | 4 | 31,627 | 21,643 | Carpenter 360 | 16 | B5 |
| Storm Windows | 155 Buildings | 14,384 | 83,702 | 7.26 | 24 | 4 | 608,383 | 452,388 | Laborer 12,057 | 33 | B14 |
| Blown-on Insulation | 47 Buildings | 20,469 | 121,563 | 7.00 | 23 | 4 | 851,340 | 434,357 | Insulator 21,420 | 35 | B15 |
| Heat Recovery From Dust Collector | 8902 | 114 | 533 | 11.90 | 18 | 3 | 6,351 | 5,873 | Sheet Metal Carpenter 8 | 38 | B17 |
| Low Pressure Sodium Street Lighting | Postwide | 3,156 | 7,131 | 51.90 | 9 | .4 | 370,504 | 319,053 | Electrician 1550 | 27 | B11 |

TABLE 9 (Cont'd)

Summary of Increment G Projects

| Project | Location (s) | Energy Savings/Year MMBtu | Dollar Savings/Year | Payback Years | E/C | D/C | Contract Cost | In-House Cost | | Reference Pages | |
|---|---------------|---------------------------------|------------------------|------------------|-----|-----|------------------|---------------|------------------|--------------------|--------|
| | | | | | | | | Material | Manhours | Narr. | Calcs. |
| Infrared Heating | 7 Buidlings | 528 | 3,695 | 23.0 | 6 | 1 | 84,865 | 51,711 | Heat Mechanic | 10 | B2 |
| High Pressure Sodium Street Lighting | Postwide | 2,041 | 4,612 | 77.6 | 6 | .3 | 357,958 | 306,506 | Electrician | 27 | B11 |
| Replace Flight Simulators | 4910 and 5102 | 76,501 | 322,834 | 204.0 | 1 | .1 | 65,856,000 | ----- | ----- | 26 | B10 |